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ABSTRACT

Scores on the four subtests of the old Medical College Admission Test (MCAT) and the six subtests of the new edition (1978) were factor analyzed. Scores were derived from similar groups of applicants. Two-factors, verbal-general information and science-quantitative, known from previous factorial studies of the old MCAT, emerged again. Five of the six subtests of the new edition load on the science-quantitative factor. Problem solving skill is not clearly differentiated from knowledge in the three science areas. Only the reading subtest loads on the verbal-general information factor so clearly assessed in the old MCAT. Most admissions committees interpret the new MCAT either by averaging all six subtests, or by determining if any subtest score falls below a preset level. The science-quantitative factor may thus inadvertently be given twice the weight of the verbal ability factor. Instead, two scores should be calculated: the mean of the four science subtests, and the mean of the two skills analysis subtests. Each candidate would then be represented by two scores, not six or one. (Author/CP)

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THE OLD AND NEW MCAT EXAMINATIONS: WHAT DO THEY MEASURE?

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Introduction

Selection of students for medical schools--as for most professional schools--is a difficult and thorny problem with very high stakes for both the applicants and the schools. Medical schools have used a standardized test as part of the admissions process for over three decades. Scores on the Medical College Admissions Test (MCAT) and grade point average (GPA) have been the principal quantitative measures for selecting medical students.

A new version of this test was developed in the 1970's and was first used widely in processing applications for medical school classes beginning in September, 1978. The new MCAT differs from the older version in three obvious respects: it yields six subtest scores instead of four, the scores are reported on a 15-point scale with a mean of 8, and it takes about twice as long to administer.

Research has already been reported (Molidor and Elstein, 1979) comparing the structure of the old and new MCAT examinations by factor analysis. It was shown that both are two-factor tests. In the old MCAT, however, by far the greatest amount of total variance was accounted for by a Verbal-General Information factor. In the new MCAT, the Science Knowledge and Science Problems subtests accounted for most of the variance.

The conclusions of our previous study and the comparison of the two versions of the MCAT were limited by the research design. Since each test was factored separately with a different cohort of students, the comparisons were only indirect. However, it was reasonable to assume that two consecutive annual cohorts of applicants to the same medical school, each cohort with over 2300 applicants, were essentially equivalent and that the results of the study reflected differences in the tests and not in the populations. Nevertheless, the plausibility of that proposition would be strengthened by a single factor analysis of both versions of the test using a single population.

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This study had two purposes. The first was to elucidate further the similarities and differences between the old and new MCAT examinations by factor analysis of test scores of a sample of applicants who took both tests. The correlation matrix of all ten subtests was analyzed in order to determine the loadings of each subtest in the resultant factorial structure. The second purpose was to determine how best to use scores from the new test in processing applications in admissions. To achieve this end, the correlation matrix of the six subtests of the new MCAT was factor analyzed separately from the old MCAT.

Method

Subjects

Data were available on 338 students who took both the old and new MCAT examinations and who applied to Michgian State University College of Human Medicine for the classes entering in Fall, 1977 and 1978. The most recent test score was used, so each student is represented only once on each examination.

Comparisons of the sample of students who took the old and new tests to the respective applicant populations showed:

1. There were no differences in the percentages of males and females.

2. There was a significant difference in the ethnic origin of the subjects in that the percentage of underrepresented minorities was lower in the sample than in either the 1977 or 1978 applicant population.

3. There was a difference in the residency of the subjects. The percentage of Michigan residents was significantly higher in the sample than in the populations.

4. There were no differences between the grade point averages of the sample and 1977 population. However, the grade point averages of the sample were lower than that of the 1978 population.

5. On the old MCAT, the sample scored lower than the 1977 population on the Verbal and General Information subtests. On the new MCAT, the sample scored higher than the 1978 population on the Biology subtest. There were no other significant differences between the sample and the respective population.

Details of these comparisons are found in Appendix 1.

Procedures

The old MCAT produced four subtest scores: Verbal, Quantitative, General Information and Science. The new MCAT yields six scores for each examinee. Three of these scores are in the area of Science Knowledge, including assessments in Biology, Chemistry and Physics. The fourth score is Science Problems, an

assessment of knowledge and problem solving ability in Biology, Chemistry and Physics. Reading Skills and Quantitative Skills are the fifth and sixth areas assessed by this new examination. Detailed descriptions of these subtests are provided in the manual for the new MCAT (AAMC, 1977).

To determine the similarities and differences between the old and new examinations, the four subtests of the old MCAT and the six subtests of the new MCAT were intercorrelated and the resulting 10 X 10 correlation matrix was factor analyzed using the SPSS program employing principal components analysis (Nie et al., 1975). The solution was then transformed using a varimax rotation.

Results and Discussion

The results of the factor analysis are presented in Table 1. The results display a two-factor varimax solution. The first factor has high loadings on the Quantitative and Science subtests of the old MCAT and on the Biology, Chemistry, Physics, Science Problems and Quantitative subtests of the new MCAT. This factor appears to be assessing a science-quantitative content domain. The second factor has high loadings on the Verbal and General Information subtests of the old MCAT and a modest loading on the Reading subtest of the new MCAT. This factor appears to be assessing a verbal ability dimension. The first factor accounts for 57.1% of the total variance (eigenvalue = 5.71), and the second factor accounts for an additional 13% of the total variance (eigenvalue = 1.30).

The results of the factor analysis indicate that when the old and new tests are factored together, they demonstrate a two-factor solution. The familiar structure of Verbal-General Information and Science-Quantitative, known from previous factorial studies of the old MCAT, appears once again. It is interesting to note that five out of the six subtests of the new MCAT load on the Science-Quantitative factor. Problem solving skill is not clearly differentiated from knowledge in the three science areas. On the new MCAT, only the Reading subtest loads on the Verbal-General Information factor so clearly assessed in the old MCAT; even here, the variance of this subtest is divided equally between the two factors. Thus, the new MCAT examination de-emphasizes assessment of verbal abilities and stresses predominantly the scientific-quantitative domain.

Since the old MCAT is no longer available for use as a selection instrument, admissions committees are faced with the task of deciding how best to use the new test. To approach this problem the 6 X 6 correlation matrix of new MCAT scores for this sample was factor analyzed. The results, presented in Table 2, clearly display a two-factor solution which is essentially identical to the solution found earlier (Molidor and Elstein, 1979). These findings suggest that the two factors must somehow be represented when an admissions committee works with these test scores.

In our experience, most admissions committees deal with the new MCAT scores either by (1) averaging the results on all six subtests to form an overall mean or (2) checking to see if any subtest score falls below a preset critical level. One consequence of both approaches is that, perhaps inadvertently,

factor one (science-quantitative) is given twice the weight of factor two (verbal-ability). If a committee desires to weight the factors equally--and we think a good case can be made for that policy--two scores should be calculated. The first is the mean of the four science subtests; and the second is the mean of the two skills analysis subtests. In this way, each candidate would be represented by two scores, not six and not one.

Table 1

FACTOR ANALYSIS OF OLD AND NEW MCAT SCORES

(n = 338)

	MCAT Subtests	Factor I	Factor II	h^2
OLD	Verbal	23	82	73
	Quantitative	69	20	52
	General Information	16	76	60
	Science	73	35	66
NEW	Science Knowledge - Biology	68	28	54
	Science Knowledge - Chemistry	86	16	77
	Science Knowledge - Physics	78	21	65
	Science Problems	87	18	79
	Skills Analysis - Reading	49	50	49
	Skills Analysis - Quantitative	68	32	56
	Total Variance Accounted For	57.1%	13.0%	

Table 2

FACTOR ANALYSIS OF NEW MCAT SCORES

(n = 338)

New MCAT Subtests	Factor I	Factor II	h^2
Science Knowledge - Biology	62	41	55
Science Knowledge - Chemistry	73	44	73
Science Knowledge - Physics	66	46	65
Science Problems	95	33	1.00
Skills Analysis - Reading	30	66	53
Skills Analysis - Quantitative	39	75	71
Total Variance Accounted For	68.1%	11.4%	

References

Association of American Medical Colleges, Division of Educational Measurement and Research. New Medical College Admission Test: Interpretive Manual. Washington, D.C.: Author, 1977.

Molidor, J.B. and Elstein, A.S. A Factor Analytic Study of the Old and New MCAT Examinations. Proceedings of the Eighteenth Annual Conference on Research in Medical Education, Association of American Medical Colleges, Washington, D.C.: 1979.

APPENDIX 1

Appendix 1

COMPARISON OF SAMPLE (n = 338) OF STUDENTS WHO TOOK THE OLD MCAT (1977) AND THE NEW MCAT (1978) TO THE RESPECTIVE POPULATIONS

1. Sex of subject: there were no differences in the percentages of males/females between the sample and the population.

		Sample	1977 Population	1978 Population
SEX	Male	68%	73%	72%
	Female	32%	27%	28%
		n = 338	n = 2880	n = 2389

Chi Square Test of Independence

$X^2 = 4.65 \qquad C_{.05,2} = 5.991$

2. Ethnic Origin of the subject: there is a difference in that the percentage of underrepresented minorities is lower in the sample than in either the 1977 or 1978 population.

		Sample	1977* Population	1978* Population
ETHNIC ORIGIN	White	84%	78%	84%
	Underrepresented Minority	6%	11%	10%
	Other	10%	11%	6%
		n = 338	n = 2843	n = 2376

* Foreign Applicants Excluded

Chi Square Test of Independence

$X^2 = 54.55 \qquad C_{.001,4} = 18.47$

3. Residency of the subject: there is a difference between the sample and the population. The percentage of Michigan residents was significantly higher in the sample than in the population.

		Sample	1977 Population	1978 Population
RESIDENCY	Michigan	74%	49%	52%
	Non-Michigan	26%	51%	48%
		n = 338	n = 2880	n = 2392

Chi Square Test of Independence

$X^2 = 75.52$ $C_{.001,2} = 13.815$

4. GPA of the subject: there are no differences between GPA of the sample and the 1977 population. The GPA of the sample is lower than that of the 1978 population.

			Sample	1977 Population	Sample	1978 Population
GPA	Science	$\bar{X}$	3.16	3.19	3.18*	3.27*
		s	.46	.52	.44	.49
	Non-Science	$\bar{X}$	3.32	3.34	3.33*	3.41*
		s	.42	.43	40	.41
	Totals	$\bar{X}$	3.23	3.26	3.25*	3.33*
		s	.39	.43	.38	.42
			n = 338	n = 2866	n = 338	n = 2375

* T-test indicates significant mean level differences between sample and population at .01 level.

5. MCAT scores: on the old MCAT, the sample scored lower than the 1977 population on the Verbal and General Information variables. On the new MCAT, the sample scored higher than the 1978 population on the Biology subtest. There were no other significant differences between the sample and respective population.

OLD MCAT

			Sample	1977 Population
MCAT	Verbal	$\bar{X}$	539*	552*
		s	89	95
	Quantitative	$\bar{X}$	595	599
		s	83	89
	General Information	$\bar{X}$	529*	539*
		s	75	82
	Science	$\bar{X}$	592	599
		s	88	96
			n = 388	n = 2866

NEW MCAT

			Sample	1978 Population
MCAT	Biology	$\bar{X}$	9.12*	8.82*
		s	2.02	2.13
	Chemistry	$\bar{X}$	8.85	8.72
		s	2.37	2.42
	Physics	$\bar{X}$	8.82	8.70
		s	2.16	2.31
	Science Problems	$\bar{X}$	8.89	8.77
		s	2.22	2.25
	Reading	$\bar{X}$	8.67	8.56
		s	2.08	2.12
	Quantitative	$\bar{X}$	8.86	8.65
		s	2.20	2.29
			n = 338	n = 2365

* T-test indicates significant mean level differences between sample and population at .01 level.